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# Patent claims

1. Method for testing the function of LCD displays comprising individual display segments (2, 3), based on the difference in the electrical capacitance of defective and intact display segments,

characterized in that

instead of measuring an electrical measuring parameter that is dependent on the capacitance of the display segments and comparing the measuring value thus measured to a reference value, the capacitance (Cseg) of the display segments is determined directly with a capacitance measuring method by measuring the electrical charge stored in the display segment (2, 3).

2. Method according to claim 1, characterized in that the capacitance of the display segments (2, 3) is determined by means of charges transferred by capacitive coupling, whereby an electrical measuring current is coupled capacitively via the capacitance (Cseg) of the display segment to be measured into an evaluation circuit and the evaluation circuit measures the charge coupled over.

3. Method according to claim 2, characterized in that the measuring current is an alternating current and in that the charge coupled over per alternating voltage period is measured, from which results the capacitance of the display segment (2, 3) provided the frequency is known.

4. Method according to claim 1 or 2, characterized in that the capacitance of the display segments is measured with a capacitance measuring method, in which a charge transfer controlled by a sequence control (6) proceeds through both the capacitance of a display segment (2, 3) to be measured and a reference capacitor (Cref), and the capacitance of the display segment (2, 3) is determined by means of a charge balance between the display segment (2, 3) to be tested and the reference capacitor (Cref).

5. Method according to claim 4, characterized in that the reference capacitor (Cref) is integrated into the LCD display.

6. Method according to any one of the preceding claims, particularly according to claim 4, characterized in that the capacitance of the display segments (2, 3) is determined by means of a capacitance measuring method utilizing a $\Delta\Sigma$ conversion.

7. Method according to any one of the preceding claims, characterized in that an automatic measuring-circuit selector is used to address individual display segments (2, 3) for the functional test.

8. Method according to claim 7, characterized in that the measuring-circuit selector is used to apply a measuring voltage to a first electrode of a display segment (2) to be tested, to connect the electrodes of other display segments (3) corresponding to said first electrode to earth in terms of alternating voltage, to measure the coupled charge on the second electrode of the display segment (2) to be tested, whereby this point is connected to virtual earth in

terms of alternating voltage, and to connect the electrodes of other display segments (3) corresponding to said second electrode to earth in terms of alternating voltage.

9. Method according to claim 8, characterized in that the first electrode is the front electrode and the second electrode is the back electrode of the display segment (2) to be tested.

10. Method according to any one of the preceding claims, characterized in that the display segments (2, 3) are triggered in a matrix structure using the multiplex procedure both for the ongoing operation of the LCD display and the functional test.

11. Method according to any one of the preceding claims, particularly according to claim 10, characterized in that the triggering levels and clock phases for triggering the display segments, in particular in a multiplex procedure, are selected such that the voltage level of the inactive display segments (3) is below the response threshold and the voltage level of the active display segments (2) is above the response threshold of the display segments (2, 3), the capacitance measuring method is performed using these voltage levels, and the switch phases of the capacitance measuring method are synchronized with the clock phases of LCD triggering.

12. Method according to claim 10 or 11, characterized in that the display segments (2, 3) are triggered direct voltage-free, on average, by means of periodical reversal of the polarity of the voltage levels.

13. Method according to any one of the preceding claims, characterized in that the capacitance measuring method is performed such that the effective voltage value of the display segment (2, 3) is identical to the value without measurement of the capacitance.

14. Method according to any one of the claims 10 to 13, characterized in that the capacitance of a display segment (2, 3) is measured during a clock phase of display segment (2, 3) triggering, whereby multiple switching processes of the capacitance measuring method are performed within this clock phase.

15. Method according to any one of the preceding claims, particularly according to claim 10, characterized in that the LCD display is triggered at low impedance for the ongoing operation and/or capacitance measurement in order to reduce the influence of coupling capacitances.

16. Method according to any one of the preceding claims, characterized in that the capacitance of the display segments (2, 3) is determined by means of the capacitance measuring method in the form of a digital measuring result and the functional test of a display segment (2, 3) is performed using the digital measuring result.

17. Method according to any one of the preceding claims, characterized in that the functional test of a display segment (2, 3) is performed during the ongoing operation of the LCD display.

18. Method according to any one of the preceding claims, characterized in that only activated display segments (2) are tested for function.

19. Method according to any one of the claims 4 to 18, particularly according to claim 17, characterized in that the sequence control (6) for the capacitance measurement and/or the measuring-circuit selector for triggering a display segment (2, 3) is modulated by and/or synchronized with the driver circuit of the LCD display.

20. Method according to any one of the claims 4 to 19, characterized in that one or more of the following components are housed in a single integrated component, e.g. an ASIC or a mixed signal FPGA: the sequence control (6) for the capacitance measurement, the measuring-circuit selector for triggering of a display segment (2, 3), the measuring circuit, the LCD driver/decoder circuit, and the analytical circuit.

21. Method according to claim 20, characterized in that an LCD triggering circuit as usually employed for driving and decoding is provided with an LCD testing facility according to the invention.

22. Method according to any one of the preceding claims, characterized in that it is performed on an LCD display that is mounted in a device, particularly a medical measuring or diagnostic device.

23. Electronic measuring system for testing the function of LCD displays comprising individual display segments (2, 3), based on the difference in the

electrical capacitance of defective and intact display segments, comprising a capacitance measuring facility that allows, instead of measuring an electrical measuring parameter that is dependent on the capacitance of the display segments and comparing the measuring value thus measured to a reference value, the capacitance (Cseg) of the display segments to be determined directly with a capacitance measuring method by measuring the electrical charge stored in the display segment (2, 3).

24. Measuring system according to claim 23, characterized in that it comprises an electronic circuit for determining the capacitance of the display segments (2, 3) by means of charges transferred by capacitive coupling, whereby an electrical measuring current is coupled capacitively via the capacitance (Cseg) of the display segment to be measured into an evaluation circuit and the evaluation circuit measures the charge coupled into it.

25. Measuring system according to claim 24, characterized in that the measuring current is an alternating current and in that the charge coupled over per alternating voltage period is measured, from which results the capacitance of the display segment (2, 3) provided the frequency is known.

26. Measuring system according to claim 23 or 24, characterized in that it comprises an electronic circuit for measuring the capacitance of the display segments with a capacitance measuring method, in which a charge transfer controlled by a sequence control (6) proceeds through both the capacitance of a display segment (2, 3) to be measured and a

reference capacitor (Cref), and the capacitance of the display segment (2, 3) is determined by means of a charge balance between the display segment (2, 3) to be tested and the reference capacitor (Cref).

27. Measuring system according to claim 26, characterized in that the reference capacitor (Cref) is integrated into the LCD display.

28. Measuring system according to any one of the claims 23 to 27, characterized in that it comprises an electronic circuit for determining the capacitance of the display segments (2, 3) by means of a $\Delta\Sigma$ conversion.

29. Measuring system according to any one of the preceding claims, characterized in that it comprises an automatic measuring-circuit selector that can be used to address individual display segments (2, 3) for the functional test.

30. Measuring system according to claim 29, characterized in that the measuring-circuit selector is designed such that a measuring voltage is applied to a first electrode of a display segment (2) to be tested, the electrodes of other display segments (3) corresponding to said first electrode are connected to earth in terms of alternating voltage, the coupled charge is measured on the second electrode of the display segment (2) to be tested, whereby this point is connected to virtual earth in terms of alternating voltage, and the electrodes of other display segments (3) corresponding to said second electrode are connected to earth in terms of alternating voltage.

31. Measuring system according to claim 30, characterized in that the first electrode is the front electrode and the second electrode is the back electrode of the display segment (2) to be tested.

32. Measuring system according to any one of the preceding claims, characterized in that the display segments (2, 3) are triggered in a matrix structure using the multiplex procedure both for the ongoing operation of the LCD display and the functional test.

33. Measuring system according to any one of the preceding claims, particularly according to claim 32, characterized in that the triggering levels and clock phases for triggering the display segments, in particular in a multiplex procedure, are selected such that the voltage level of the inactive display segments (3) is below the response threshold and the voltage level of the active display segments (2) is above the response threshold of the display segments (2, 3), the capacitance measuring method is performed using these voltage levels, and the switch phases of the capacitance measuring method are synchronized with the clock phases of LCD triggering.

34. Measuring system according to claim 32 or 33, characterized in that the display segments (2, 3) are triggered direct voltage-free, on average, by means of periodical reversal of the polarity of the voltage levels.

35. Measuring system according to any one of the preceding claims, characterized in that the capacitance measuring method is performed such that the effective voltage value of the display segment

(2, 3) is identical to the value without measurement of the capacitance.

36. Measuring system according to any one of the claims 32 to 35, characterized in that the capacitance measuring method is performed during a clock phase of the triggering of the display segments (2, 3), whereby multiple switching processes of the capacitance measuring method are performed within this clock phase.

37. Measuring system according to any one of the preceding claims, particularly according to claim 32, characterized in that the LCD display is triggered at low impedance for the ongoing operation and/or capacitance measurement in order to reduce the influence of coupling capacitances.

38. Measuring system according to any one of the preceding claims, characterized in that the capacitance of the display segments (2, 3) is determined by means of the capacitance measuring method in the form of a digital measuring result and the functional test of a display segment (2, 3) is performed using the digital measuring result.

39. Measuring system according to any one of the preceding claims, characterized in that the functional test of a display segment is performed during the ongoing operation of the LCD display.

40. Measuring system according to any one of the preceding claims, characterized in that only activated display segments (2, 3) are tested for function.

41. Measuring system according to any one of the claims 26 to 40, particularly according to claim 39, characterized in that the sequence control for the capacitance measurement and/or the measuring-circuit selector for triggering a display segment (2) is modulated by and/or synchronized with the driver circuit of the LCD display.

42. Measuring system according to any one of the claims 26 to 41, characterized in that one or more of the following components are housed in a single integrated component, e.g. an ASIC or a mixed signal FPGA: the sequence control (6) for the capacitance measurement, the measuring-circuit selector for triggering of a display segment (2, 3), the measuring circuit, the LCD driver/decoder circuit, and the analytical circuit.

43. Measuring system according to claim 42, characterized in that it comprises an LCD triggering circuit as usually employed for driving and decoding that is provided with an LCD testing facility according to the invention.

44. Measuring system according to any one of the preceding claims, characterized in that it is integrated into a device with a built-in LCD display, particularly a medical measuring or diagnostic device.

45. Medical measuring or diagnostic device comprising a measuring system according to any one of the preceding claims.